# PATENT ABSTRACTS OF JAPAN

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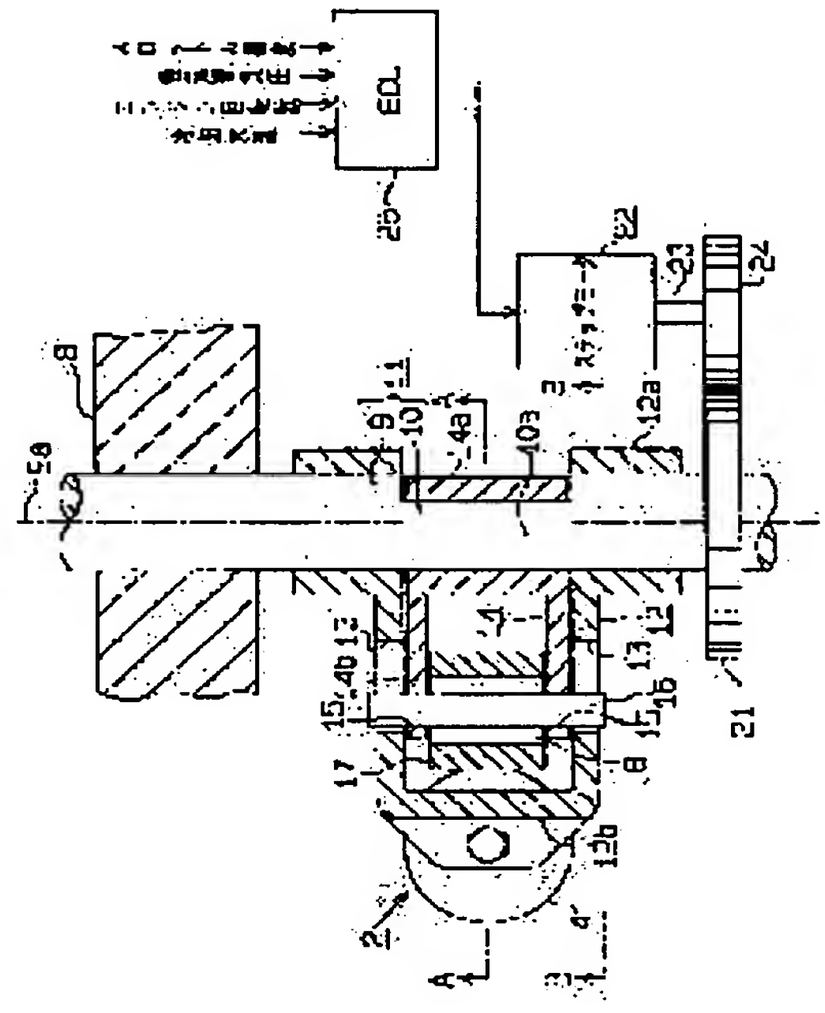
## (54) VALVE DRIVE MECHANISM FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PURPOSE: To prevent occurrence of knocking sound and operate a valve driving mechanism at a high speed, following up a high rotational speed of an engine.
CONSTITUTION: An outer arm 12 made at its distal end in contact with a valve in a valve mechanism 2 is swingably supported to a body part 9 having a center axis 9a aligned with the rotational center of a rocker shaft 11. A pair of elongated holes 13 are formed at opposite sides of the outer arm 12 on a circle concentric with a base circle. An inner arm 14 is swingably supported to an eccentric part 10 having a center axis 10a eccentric from the rotational center. A roller shaft 16 is supported in an axial hole 15 in the inner arm 13 and is inserted in the elongated hole 13 so as to be guided in the latter. When a rocker shaft 4 is rotated, the outer arm 12 is moved, relative to the outer arm 12, so that the contact point of a cam on the roller 17 varies. As result, the lift of the valve and the like are changed. Even though the contact point of the cam is changed, the distance between the center of the cam and the center of the roller 17 is not changed.




## LEGAL STATUS

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## CLAIMS

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[Claim(s)]
[Claim 1] It is the valve gear of the internal combustion engine for making the bulb for an internal combustion engine's pumping drive. The rocker shaft which consisted of the eccentric section to which eccentricity of the axial center was carried out to the body section and its body section, and was supported by locker housing rotatable focusing on the axial center of said body section, While being prepared on said internal combustion engine's cam shaft, and the cam equipped with the base circle and the end face section being supported by said body section rockable and making said bulb drive in an abbreviation point While being supported to the 1st rocker arm which has the guide section formed on the approximately concentric circle of said base circle on both sides, the 2nd rocker arm by which the end face section was supported by said eccentric section rockable, and said 2nd rocker arm While being supported pivotable with the roller shaft which contacted said guide section of said 1st rocker arm, and was supported possible [ relative displacement ] to said 1st rocker arm, and said roller shaft The valve gear of the internal combustion engine characterized by having the roller formed possible [ contact for said cam ].

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the valve gear for making the bulb for an internal combustion engine's pumping drive, and relates to the valve gear which makes adjustable the amount of valve lifts, and valve timing in detail.
[0002]
[Description of the Prior Art] Conventionally, what was indicated by JP,60-75610,U is known as this kind of a technique. With this technique, as shown in drawing 12 , the bulb 52 for pumping is formed in the engine cylinder head 51. Moreover, the rocker arm 54 is supported by the rocker shaft 53 rockable in the vertical direction focusing on the axial center. By the splash of this rocker arm 54, the bulb 52 located in the rocker arm 54 head lower part is opened and closed.
[0003] Moreover, the slot 56 prolonged in the shape of a straight line is formed in the direction of an axis of a cam 55, and the direction which intersects perpendicularly at the both sides of a rocker arm 54. The roller shaft 57 is inserted in in this slot 56, and the roller 58 is supported by the roller shaft 57 pivotable, where a cam 55 is contacted. Furthermore, as the rocker arm 54 is pinched in the outside of a rocker arm 54, the U-shaped frame 59 is formed in it, and the ends of the roller shaft 57 are supported by the frame 59.
[0004] In the above-mentioned valve gear, with the revolution of a cam 55, when the cam-nose 55a contacts a roller 58, a roller 58 is pressed below. And a rocker arm 54 is rocked by the thrust considering a rocker shaft 53 as the supporting point. By this splash, the bulb 52 prepared at rocker arm 54 head resists the energization force of a coil spring 60, and is moved to this drawing lower part, and pumping opening which is not illustrated is opened. Then, with the further revolution of a cam 55, when cam base 55b of a cam 55 contacts a roller 58, a bulb 52 is moved to this drawing upper part by the energization force of a coil spring 60, and pumping opening is closed. And a bulb 52 moves up and down by the repeat of the above-mentioned actuation, and pumping opening is opened and closed.
[0005] Moreover, in the rocker arm 54, the solenoid 61 and moving core 62 for moving a roller 58 to this drawing longitudinal direction are established. And a moving core 62 is moved to this drawing longitudinal direction by changing suitably the electrical potential difference impressed to a solenoid 61. In connection with this, a frame 59 is moved to this drawing longitudinal direction, and the roller shaft 57 and a roller 58 are moved to the longitudinal direction of a slot 56. Therefore, the contact location to the roller 58 of a cam 55 is changed. Consequently, the amount of splashes of the timing and the rocker arm 54 which hit the roller 58 of cam-nose 55a is changed, and the closing motion timing and its amount of lifts of a bulb 52 are changed.
[0006]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional technique, it was only formed so that it might extend to the direction where the slot 56 for guiding migration of a roller 58 only intersects perpendicularly in the direction of an axis of a cam 55, i.e., this drawing longitudinal direction, in the shape of a straight line. Therefore, the roller shaft 57 and a roller 58 will be linearly moved along with this slot 56, and the distance between the center of rotation C1 of a cam 55 and the center of rotation C2 of a roller 58 will change with migration of that roller 58. That is, when the roller 58 was moved to the right edge of a slot 56 shown according to a two-dot chain line from the left end section of the slot 56 shown as a continuous line, the distance of the center of rotation C1 of a cam 55 and the center of rotation C2 of a roller 58 will increase, and there was a possibility that a tappet clearance S might become large beyond the need between the peripheral face of a roller 58 and a cam 55. And when a tappet clearance S became large beyond the need in this way at the time of the revolution of a cam 55, cam-nose 55a will strike

a roller 58, and there was a possibility that a tap tone might occur as a result.
[0007] Moreover, with the above-mentioned technique, the solenoid 61 for moving roller 58 grade is formed in the rocker arm 54. For this reason, when the inertia weight of a rocker arm 54 tended to increase and only the part of that solenoid 61 tended to make it rock a rocker arm 54 with a high-speed revolution of an engine at high speed, the flattery nature of a rocker arm 54 was not good.
[0008] It is in this invention being made in view of the situation mentioned above, and offering the valve gear of an internal combustion engine with that object being the valve gear of the internal combustion engine for making the bulb for an internal combustion engine's pumping drive, and possible and preventing generating of the tap tone which originates in the tappet clearance between a cam and a roller at the time of the revolution of a cam, and possible making a bulb follow a high-speed revolution of an internal combustion engine, and making it drive at high speed.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned object, it sets to this invention. It is the valve gear of the internal combustion engine for making the bulb for an internal combustion engine's pumping drive. The rocker shaft which consisted of the eccentric section to which eccentricity of the axial center was carried out to the body section and its body section, and was supported by locker housing rotatable focusing on the axial center of the body section, While being prepared on an internal combustion engine's cam shaft, and the cam equipped with the base circle and the end face section being supported by the body section rockable and making a bulb drive in an abbreviation point While being supported to the 1st rocker arm which has the guide section formed on the approximately concentric circle of a base circle on both sides, the 2nd rocker arm by which the end face section was supported by the eccentric section rockable, and the 2nd rocker arm While being supported pivotable with the roller shaft which contacted the guide section of the 1st rocker arm and was supported possible [ relative displacement ] to the 1st rocker arm, and a roller shaft The valve gear of the internal combustion engine characterized by having the roller formed possible [ contact for a cam ] is made into the summary.
[0010]
[Function] According to the above-mentioned configuration, a roller is pressed by the cam when the cam prepared in an internal combustion engine's cam shaft rotates. The thrust is transmitted to the 1st rocker arm through a roller shaft, and the 1st rocker arm is rocked. A bulb is opened and closed by the abbreviation point of the 1st rocker arm with this splash.
[0011] Here, unlike the 1st rocker arm, the 2nd rocker arm is supported by the eccentric section which has the axial center which carried out eccentricity to the axial center of a rocker shaft. For this reason, when a rocker shaft rotates, it will be moved a roller shaft being guided in the guide section, and a roller shaft, a roller, and the 2nd rocker arm will be relatively moved to the 1st rocker arm. Consequently, the contact location to the roller of a cam changes and the timing by which closing motion actuation of the bulb is carried out, and its amount of lifts are changed. Since the guide section is formed on the approximately concentric circle of a base circle at this time, the distance of the center of rotation of a cam and the center of rotation of a roller does not change with migration of a roller. Therefore, the tappet clearance between a cam and a roller does not become large beyond the need with the revolution of a cam.
[0012] Furthermore, since relative displacement of the roller is carried out to the 1st rocker arm when a rocker shaft rotates, it is not necessary to establish the means to which a roller is moved separately to the 1st or 2nd rocker arm. For this reason, the inertia weight of a rocker arm is mitigated only for the part which does not establish the means to which a roller is moved separately.
[0013]
[Example]
(The 1st example) The 1st example which materialized an internal combustion engine's valve gear in this invention is hereafter explained to a detail based on a drawing.
[0014] Drawing 1 is the outline block diagram showing the valve gear of the engine as an internal combustion engine carried in the car in this example, drawing 2 is the A-A line sectional view of drawing 1 , and drawing 3 is the B-B line sectional view of drawing 1 . As shown in these drawings, the well-known valve mechanism 2 is formed in the engine cylinder head 1. This valve mechanism 2 is formed between the bulb 3 for exhaust air prepared possible [ vertical movement ] to the cylinder head 1, the bulb retainer 4 prepared in the bulb 3 upside section, the bulb retainer 4, and the cylinder head 1, and consists of coil spring 6 grades which energize a bulb 3 upwards.
[0015] This valve mechanism 2 is driven by the valve gear based on the revolution of the cam 7 prepared on the cam shaft. Below, the valve gear is explained.

[0016] As shown in drawing 1 , the rocker shaft 11 which consists of the body section 9 and the eccentric section 10 is supported by the engine locker housing 8 rotatable. As for the body section 9 of this rocker shaft 11, nothing and its axial center 9a have taken the rotation lead in a rocker shaft 11 in the shape of a cylinder. Moreover, rather than the body section 9, the eccentric section 10 is a minor diameter, and as it is inserted into the body section 9, it is really formed. Furthermore, eccentricity of the axial center 10a of the eccentric section 10 is carried out to axial center 9a of the body section 9.
[0017] The outer arm 12 as the 1st rocker arm is supported rockable in the end face section 12a by the body section 9. Point 12b of the outer arm 12 is contacted by the above mentioned valve mechanism 2. And a bulb 3 is pressed in the point with the splash of the outer arm 12.
[0018] Moreover, the slot 13 of the couple as the guide section is formed in the both sides of the outer arm 12. The slot 13 of these couples is formed on the concentric circle of the base circle B of the cam 7 prepared in the cam shaft. In addition, a cam 7 is a well-known thing and consists of cam-nose 7b with a distance longer than cam base 7a to a periphery from the bottom of its heart cam base 7a which has the configuration where it **(ed) in a base circle B, and during the revolution. Moreover, in this example, a cam shaft and a cam 7 shall serve as mutual one, and shall be rotated to drawing 2 and the counterclockwise rotation of 3.
[0019] On the other hand, as it is pinched by the outer arm 12, the inner arm 14 as the 2nd rocker arm is supported by the eccentric section 10 of a rocker shaft 11 rockable in the end face section 14a. The axial hole 15 of a couple is formed in the both sides of abbreviation point 14b of this inner arm 14, and the roller shaft 16 is supported by the coaxial hole 15. Moreover, the roller shaft 16 is prolonged in the slot 13 of the outer arm 12, and migration within this slot 13 is permitted. Furthermore, the roller 17 is supported pivotable through the needle 18 to the roller shaft 16. As shown in drawing 2 and 3, this roller 17 is contacted by the underside of a cam 7.
[0020] That is, a cam 7 faces rotating and cam-nose 7b of a cam 7 is contacted by the roller 17. And a roller 17 is pressed by contact of cam-nose 7b, and this thrust is transmitted to the outer arm 12 through a roller 17 and the roller shaft 16. Therefore, as the outer arm 12 shows by the two-dot chain line arrow head, it is rocked below. With the splash to this lower part, the bulb 3 located in the abbreviation point 12b lower part of the outer arm 12 resists the energization force of a coil spring 6, it is pressed below, and an exhaust port is opened. Moreover, if cam base 7a is contacted by the roller 17, the outer arm 12 will be rocked upwards by the energization force of a coil spring 6. Besides, by the splash to a way, a bulb 3 is returned upwards and an exhaust port is closed. Thus, with revolution actuation of a cam 7, a bulb 3 moves up and down and closing motion of the above-mentioned exhaust port is performed repeatedly.
[0021] As shown in drawing 1 , the passive-movement gear 21 has fixed on the body section 9 of a rocker shaft 11. Moreover, this passive-movement gear 21 has geared on the actuation gear 24 which fixed on the motor shaft 23 of a step motor 22. And when a step motor 22 drives, the actuation gear 24 rotates. The passive-movement gear 21 rotates with this rotation, and a rocker shaft 11 rotates.
[0022] Moreover, in this example, the electronic control (ECU) 25 for carrying out actuation control of the step motor 22 is formed. Various kinds of signals equivalent to cooling water temperature, an engine speed, inlet-pipe negative pressure, a throttle opening, etc. are inputted into this ECU25 from the various sensors for detecting engine operational status. The step motor 22 is electrically connected to the output side of ECU25. And ECU25 outputs the control signal for actuation to a step motor 22 based on these various signals that the amount of lifts and closing motion timing of a bulb 3 should be adjusted according to the occasional operational status. That is, when the condition of the present engine is in a low loading condition, ECU25 rotates a step motor 22 normally, and, in the case of a heavy load condition, is controlled to reverse a step motor 22, for example. In connection with this, a rocker shaft 11 rotates to a clockwise rotation or a counterclockwise rotation.
[0023] Next, an operation of the valve gear of the engine constituted as mentioned above is explained. When normal rotation actuation of the step motor 22 is carried out by control of ECU25, as shown in drawing 1 , the roller shaft 16 is moved to the head side in a slot 13 (this drawing left-hand side). A roller 17 is also located in the left-hand side of the outer arm 12 in connection with this.
[0024] On the other hand, when inversion actuation of the step motor 22 is carried out, a rocker shaft 11 rotates to an opposite direction with the above-mentioned case. Since eccentricity of the axial center 10a of the eccentric section 10 is carried out to axial center 9a of the body section 9 at this time, when 180 degrees rotates, as shown in drawing 4 , the inner arm 14 currently supported by the eccentric section 10 moves [ a rocker shaft 11 ] to the method of the right from the condition of drawing 1 to the outer arm 12. Here, the roller shaft 16 is guided within a slot 13, and is displaced relatively to the end face side (this drawing right-hand side). Moreover, since the roller 17 is supported to the roller shaft 16 moved, it also moves this roller

17.to right-hand side. Therefore, it will differ from the case where the contact location to the roller 17 of a cam 7 is the above.

[0025] When are explained more to the detail and a step motor 22 rotates normally, a bulb 3 carries out a motion as shown as the continuous line of drawing 5 with the revolution of a cam 7. Moreover, when a step motor 22 is reversed, a bulb 3 carries out a motion as shown according to the two-dot chain line of drawing 5 with the revolution of a cam 7. That is, when a step motor 22 is reversed, compared with the case where this step motor 22 rotates normally, only a part for a roller 17 to move to right-hand side is in the timing to which cam-nose 7b contacts a roller 17. Therefore, the timing by which closing motion actuation of the bulb 3 is carried out is overdue. Moreover, when a step motor 22 is reversed, the amount L2 of lifts of a bulb 3 (the maximum movement magnitude) becomes large compared with the amount L1 of lifts when a step motor 22 rotates normally. In addition, when the rotational speed of a cam 7 is fixed, the time amount Ta and Tb by which the bulb 3 is opened regardless of the location of a roller 17 and the roller shaft 16 becomes fixed.

[0026] Here, the slot 13 in this example is formed on the base circle B of a cam 7, and the concentric circle. For this reason, when a roller 17 is moved as mentioned above and the contact location to the roller 17 of a cam 7 is changed, the distance of the center of rotation of a cam 7 and the center of rotation of a roller 17 does not change. Therefore, the tappet clearance between a cam 7 and a roller 17 does not become large beyond the need. Consequently, generating of the tap tone between cam-nose 7b resulting from buildup of a tappet clearance and a roller 17 can be prevented.

[0027] Moreover, in this example, since the relative displacement of the roller 17 was made to be carried out to the outer arm 12 when a rocker shaft 11 rotated, it is not necessary to establish means to which a roller 17 is moved separately, such as a solenoid device, to the outer arm 12. For this reason, only the part which does not establish the means to which a roller 17 is moved separately can attain lightweight-ization of the inertia weight of the outer arm 12. Therefore, when you try to make it rock the outer arm 12 with a high-speed revolution of an engine at high speed, the flattery nature of the outer arm 12 can be improved.

[0028] Furthermore, in this example, when an engine has the Taki cylinder, it is not necessary to establish the means to which a roller 17 is moved for every cylinder, and adjustment of the switching action of the bulb 3 of each cylinder can be provided with one rocker shaft 11. Therefore, only the part can attain simplification of the whole configuration.

[0029] (The 2nd example) Next, the 2nd example which materialized an internal combustion engine's valve gear in this invention is explained based on drawing 6 and 7. In addition, in this example, the sign same about the same member as the configuration of the 1st example mentioned above is attached, explanation is omitted, and it explains focusing on a different point.

[0030] As shown in drawing 6 , in this example, the eccentric section 33 serves as said 1st example to the body section 32 of a rocker shaft 31 at the major diameter at reverse. Moreover, the rocker shaft 31 is supported rotatable to locker housing which is not illustrated focusing on axial center 32a of the body section 32. Furthermore, eccentricity of the axial center 33a of the eccentric section 33 is carried out to axial center 32a of the body section 32.

[0031] The inner arm 34 as the 1st rocker arm is supported rockable at the end face section 34a by the body section 32. The slot 35 of the couple as the guide section located on the concentric circle of the base circle B is formed in the both sides of this inner arm 34.

[0032] On the other hand, as the inner arm 34 is pinched in the eccentric section 33 of a rocker shaft 31, the outer arm 36 as the 2nd rocker arm is supported rockable in the end face section 36a. The roller shaft 16 is supported by the axial hole 37 of the both sides of abbreviation point 36b of the outer arm 36. Moreover, the roller 17 is supported by the roller shaft 16 pivotable. The roller shaft 16 is prolonged in the slot 35 of the inner arm 34, and is guided within this slot 35. Furthermore, the thrust washer 38 intervenes between the roller 17 and the inner arm 34. Migration to this drawing longitudinal direction of a roller 17 is smoothly performed by this thrust washer 38.

[0033] Next, an operation of the valve gear constituted as mentioned above is explained. First, when a step motor 22 rotates normally, the roller shaft 16 is located in the head side in a slot 35 (this drawing left-hand side). A roller 17 is also located in the left-hand side of the inner arm 34 in connection with this. Moreover, when a step motor 22 is reversed, as shown in drawing 6 and 7, relative displacement of the outer arm 36 currently supported by the eccentric section 33 is carried out to the inner arm 34 to the method of the said ****. Therefore, the roller shaft 16 is moved to the end face side in a slot 35 (this drawing right-hand side), and a roller 17 is also moved to the right-hand side of the inner arm 34. Therefore, it will change compared with the case where the contact location to the roller 17 of a cam 7 is the above. That is, when a step motor

22.is reversed, compared with the case where a step motor 22 rotates normally, delay and the amount of lifts of a bulb 3 (the maximum movement magnitude) become [ the timing by which closing motion actuation of the bulb 3 is carried out ] large.
[0034] Also in this example, the slot 35 was formed on the concentric circle of the base circle B like said 1st example. Therefore, even if the contact location to the roller 17 of a cam 7 is changed, effectiveness equivalent to said 1st example that generating of a tap tone can be prevented is done so.
[0035] Moreover, only the part which does not need to establish the means to which a roller 17 is moved separately can attain lightweight-ization, and the flattery nature of the inner arm 34 accompanying a high-speed revolution of an engine can be improved.
[0036] Furthermore, only the part which does not need to establish the means to which a roller 17 is moved for every cylinder can attain simplification of the whole configuration.
(The 3rd example) Next, the 3rd example which materialized an internal combustion engine's valve gear in this invention is explained based on drawing 8 and 9. In addition, in this example, the sign same about the same member as the configuration of the 1st and 2nd example mentioned above is attached, explanation is omitted, and it explains focusing on a different point.
[0037] As shown in drawing 8 , in this example, the eccentric section 33 is a major diameter to the body section 32 of a rocker shaft 31 like said 2nd example. Moreover, the rocker shaft 31 is supported rotatable to locker housing which is not illustrated focusing on axial center 32a of the body section 32. Furthermore, eccentricity of the axial center 33a of the eccentric section 33 is carried out to axial center 32a of the body section 32.
[0038] The inner arm 39 as the 1st rocker arm is supported rockable at the end face section 39a by the body section 32. The guide slot 40 of the couple as the guide section is formed in this inner arm 39 by scooping out a part of that both-sides upper part. The top face of the guide slot 40 is located on the concentric circle of the base circle B.
[0039] On the other hand, as the inner arm 34 is pinched in the eccentric section 33 of a rocker shaft 31, the outer arm 41 as the 2nd rocker arm is supported rockable in the end face section 41a. The roller shaft 42 is supported by the axial hole 37 of the both sides of abbreviation point 41b of the outer arm 41. Major diameter 42a is prepared in this roller shaft 42, and it is supported pivotable on the above-mentioned guide slot 40. That is, it shows around, rotating on the roller shaft 42 in the guide slot 40.
[0040] Although the almost same operation as the 2nd example described above also in this example is done so, by this example, it differs greatly to showing around, while the roller shaft 16 slides within a slot 35 in the 2nd example at the point guided major diameter 42a of the roller shaft 42 rotating in the guide slot 40. That is, although the roller shaft 42 is guided with rotation of a rocker shaft 31 in the guide slot 40, since it moves at this time while the roller shaft 42 rotates, frictional force seldom occurs between the guide slot 40 and the roller shaft 42. Therefore, generating of wear resulting from migration of the repeat of the roller shaft 42 can be prevented beforehand, as a result the endurance of this valve gear can be raised.
[0041] In addition, this invention is not limited to said example, in the range which does not deviate from the meaning of invention, can change a part of configuration suitably, and can also carry it out as follows.
(1) Although it constituted from said each example so that the motor shaft 23 and the actuation gear 24 might be rotated and the follower gear 21 and rocker shafts 11 and 31 might be rotated by forming the follower gear 21 in rocker shafts 11 and 31, and making a step motor 22 drive, it is good also as the other configuration.
[0042] For example, as shown in drawing 10 , a pinion 43 is fixed on a rocker shaft 11 and 31, the pinion 43 is rotated with the rack 45 which moves by the solenoid 44, and you may make it rotate rocker shafts 11 and 31.
[0043] Moreover, as shown in drawing 11 , an arm 46 is fixed on a rocker shaft 11 and 31, the arm 46 is rotated through a link 48 by the moving core 47 which moves by the solenoid 44, and you may make it rotate rocker shafts 11 and 31.
[0044] (2) Although considered as the configuration which applies the valve gear concerning this invention to the bulb 3 for exhaust air in said each example, you may apply to the bulb for inhalation of air.
(3) Although the hand of cut of the cam 7 in said each example was made into the same direction as the splash direction of the outer arm 12 and the inner arms 34 and 39, i.e., drawing 3 , and the counterclockwise rotation of 7 and 9, the hand of cut of a cam 7 may be reverse.
[0045] (4) Relation of the major-diameter minor diameter of each body sections 9 and 32 of the rocker shafts 11 and 31 in said each example and each eccentric sections 10 and 33 may be made into mutual reverse. That is, the body section 9 may be made into a minor diameter rather than the eccentric section 10,

or.the body section 32 may be made into a major diameter rather than the eccentric section 33.
[0046]
[Effect of the Invention] While making the body section from which that axial center takes the rotation lead in a rocker shaft support the 1st rocker arm in the valve gear of the internal combustion engine for making an internal combustion engine's bulb for pumping drive as explained in full detail above according to this invention Since make the eccentric section support the 2nd rocker arm, and form a slot in the 1st rocker arm on the approximately concentric circle of a base circle, a roller shaft is made to insert in and it was made to move the roller on the approximately concentric circle of a base circle When a rocker shaft rotates and the contact location to the roller of a cam changes, the outstanding effectiveness that generating of the tap tone at the time of the revolution of a cam can be prevented is done so.
[0047] Moreover, only the part which does not need to establish the means to which a roller is moved separately can attain lightweight-ization, it has it, and the outstanding effectiveness of the ability to make a bulb able to follow a high-speed revolution of an internal combustion engine, and make it driving is done so.

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DRAWINGS

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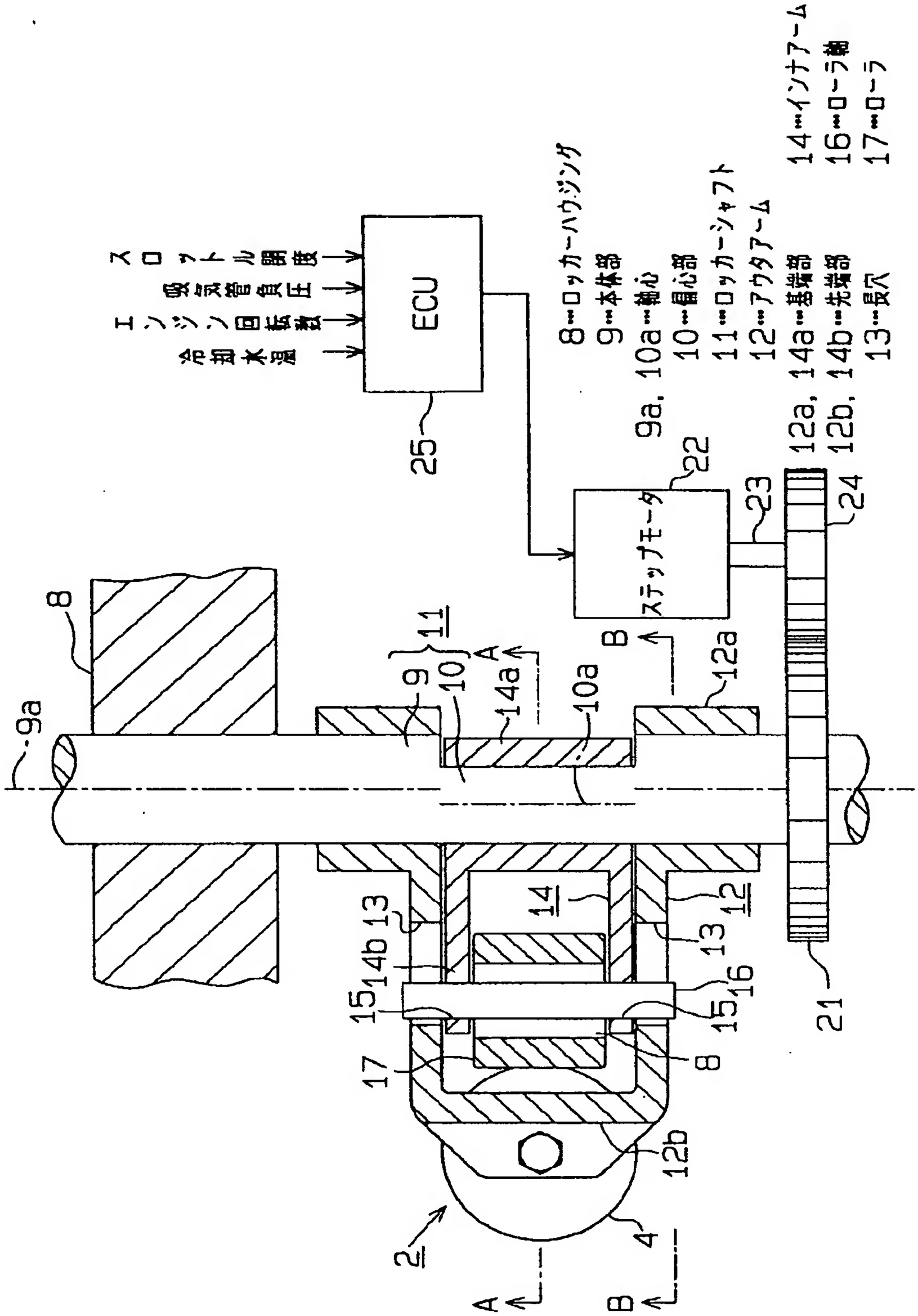
[Drawing 1]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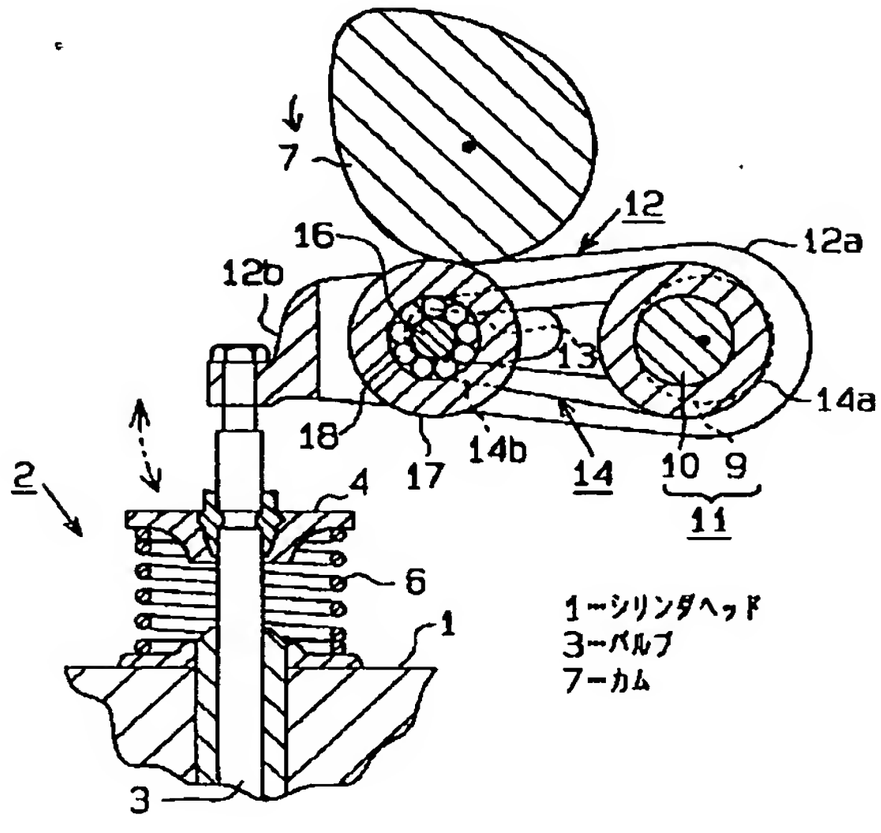
[Drawing 2]

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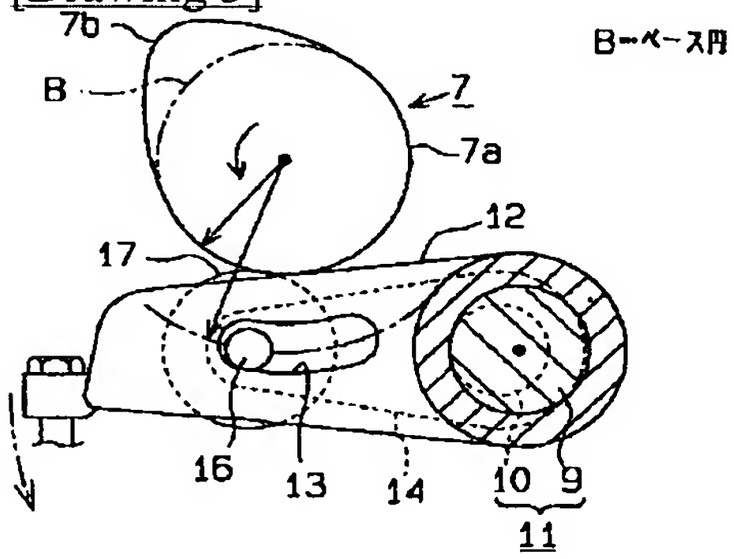


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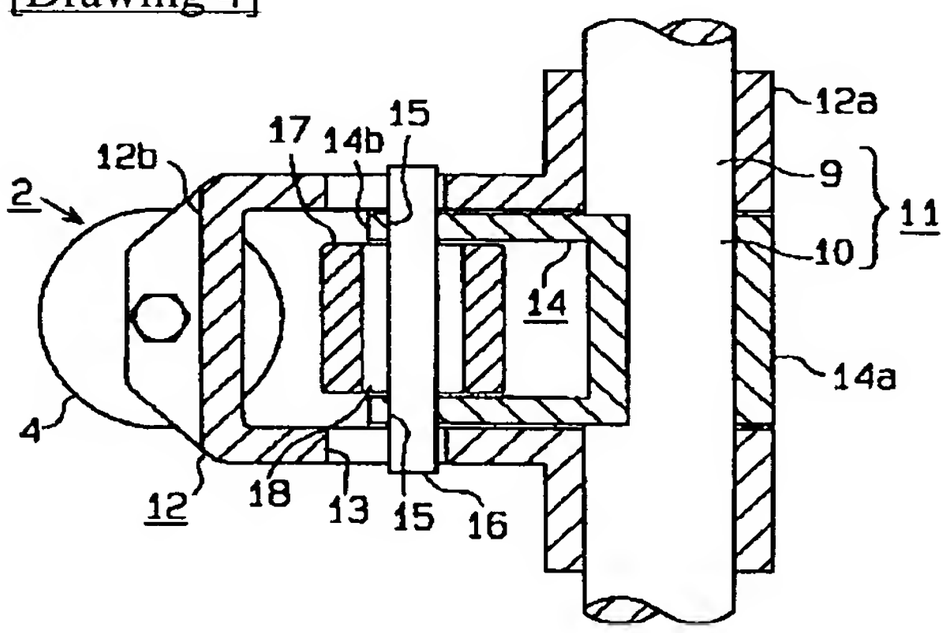
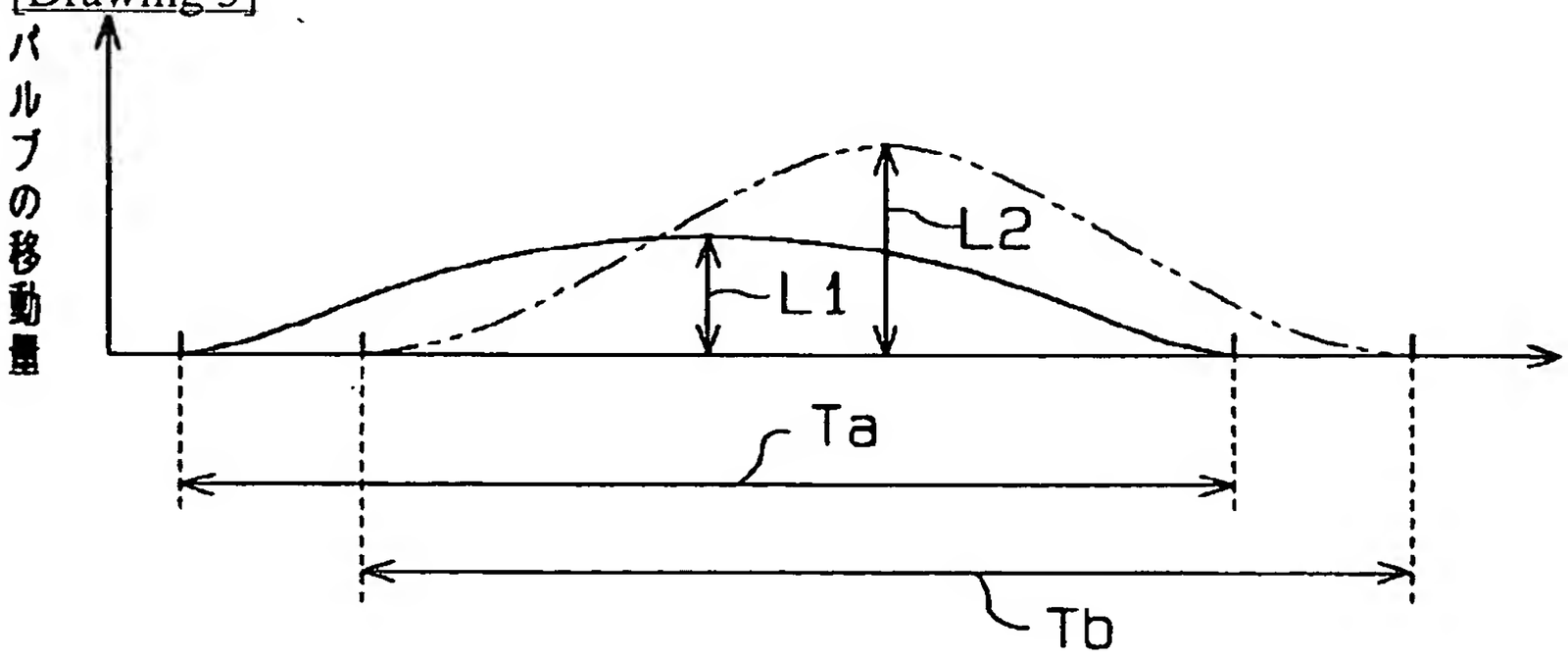
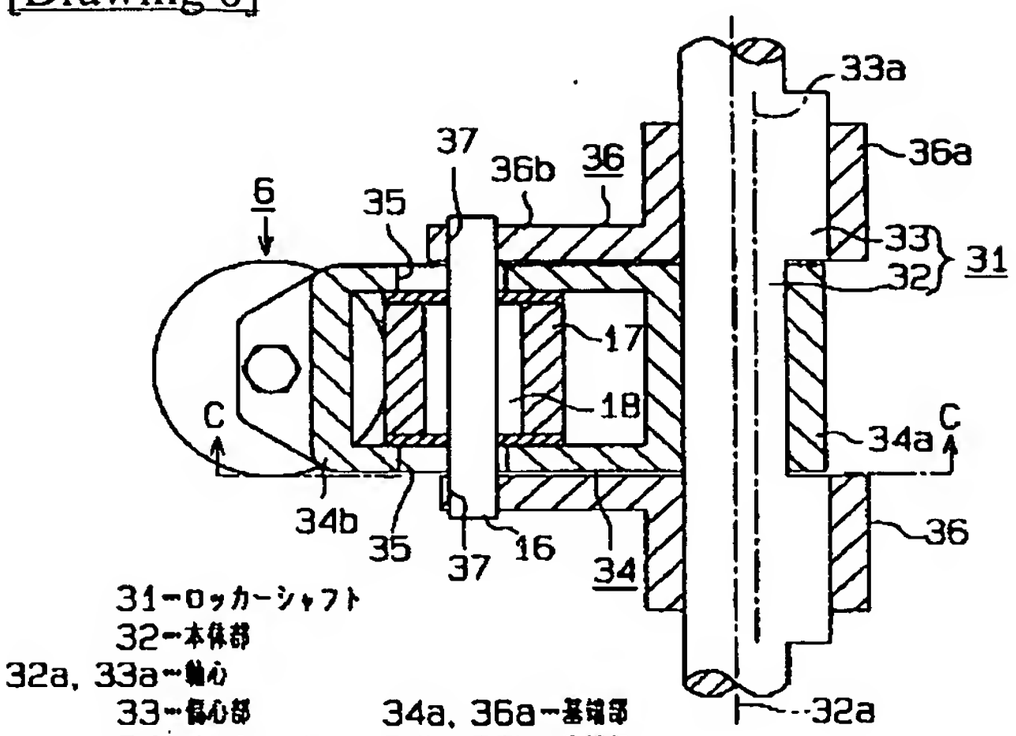


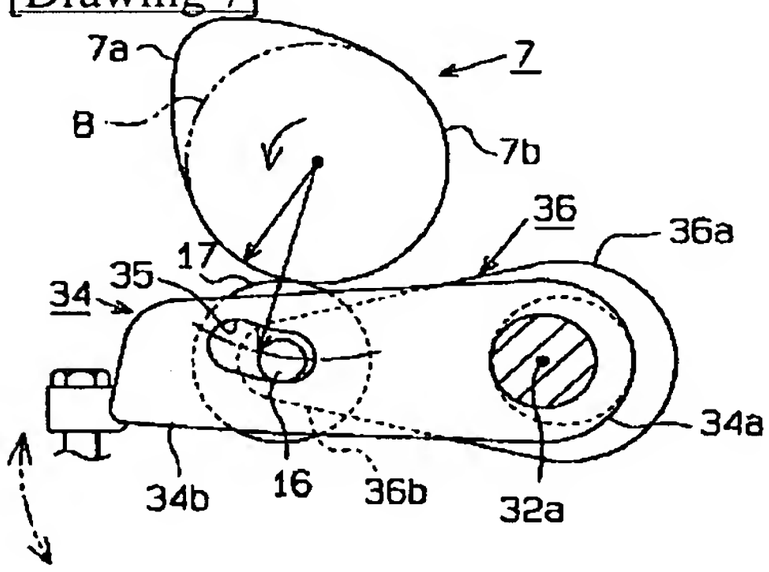

[Drawing 5]



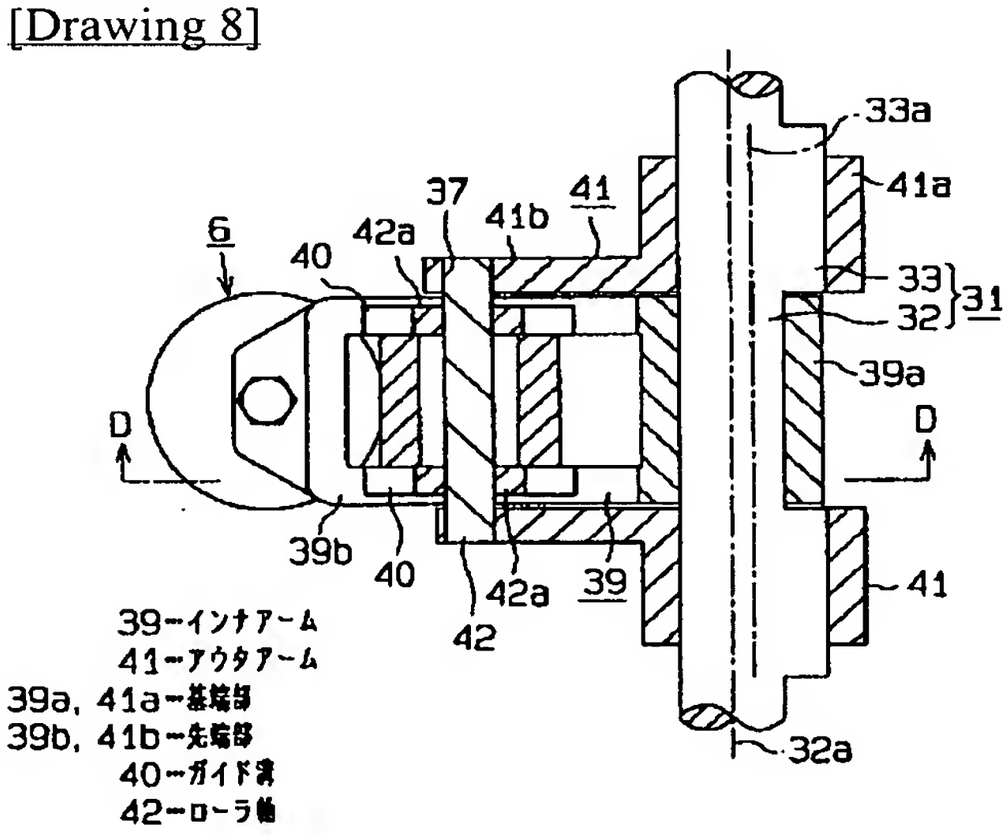
[Drawing 6]



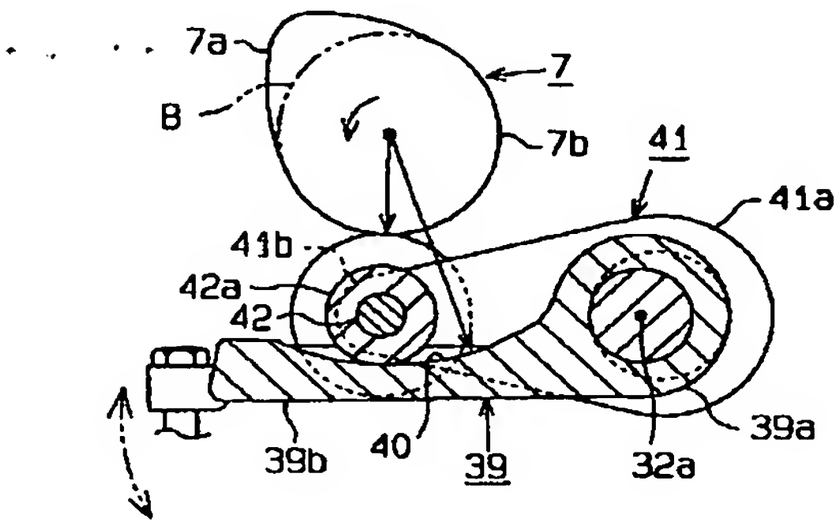

[Drawing 7]




[Drawing 8]




[Drawing 9]

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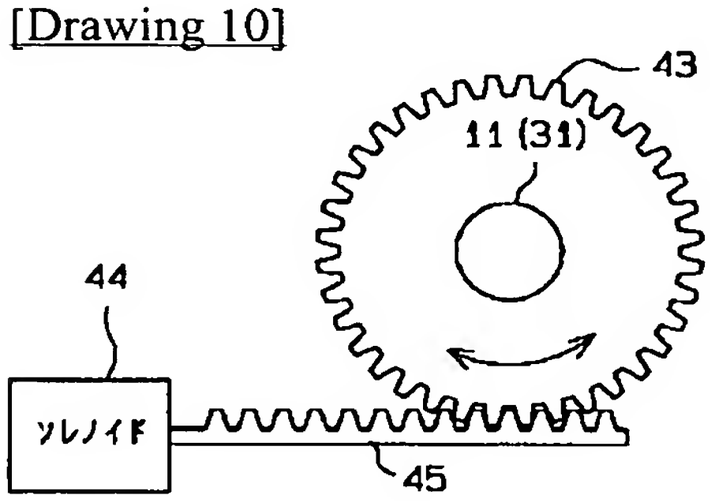
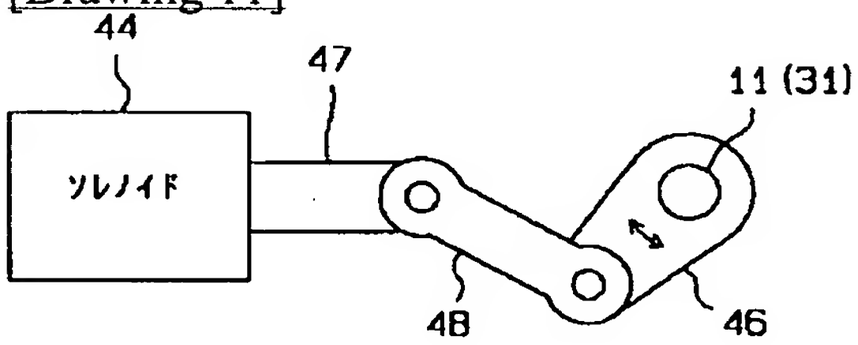
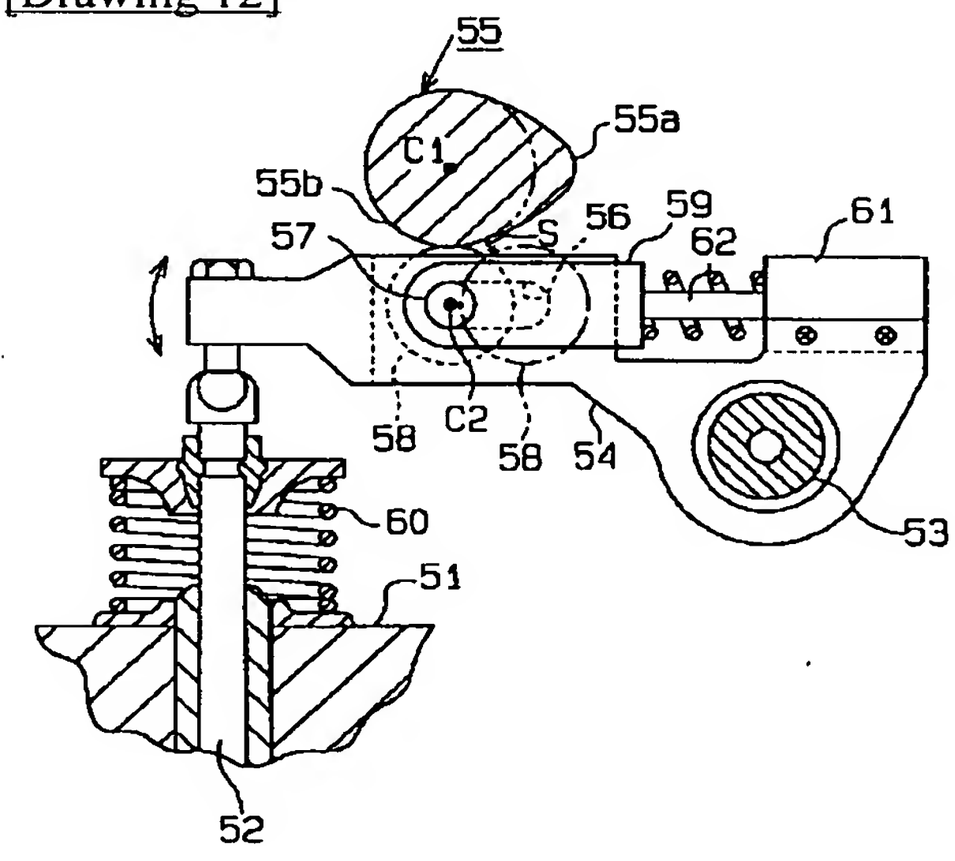



[Drawing 11]




[Drawing 12]

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[Translation done.]